

MWD Comments on Draft Delta Risk Management Strategy Phase 2 Report

Comment Highlights.

As a member of the Delta Risk Management Strategy (DRMS) Steering Committee, MWD has emphasized the importance of identifying the separable net benefits of building blocks to provide the opportunity for trade off evaluations essential to the development of optimized scenarios with broad, economically justified and balanced benefits. The Phase 1 DRMS report excluded an analysis of net economic benefits of building blocks, and the Phase 2 DRMS report does not perform this task. The crafting of various building blocks into overall scenarios should have first identified the separable economic benefits of its component parts (building blocks). The combining of a series of Delta actions for benefit assessment before performing the separable benefits assessment tends to mask the values of individual risk reduction strategies for decision makers. Clear reporting and comparative methodologies are needed for economic benefit analyses. Importantly, the DRMS process recognizes that the evaluation of optimized scenarios requires an iterative process, taking advantage of the knowledge gained from initial concepts and making adjustments in analyses to achieve more balanced, optimized scenarios.

The DRMS Phase 2 report properly recognizes the importance of an Enhanced Emergency Preparedness/Response Plan for the Delta. Such a plan is endorsed by water interests reliant on exports from the Delta and is being developed through the efforts of state, federal and local entities. It is commendable that DWR has developed an Interim Emergency Operations Plan for major Delta emergencies, and has initiated a collaborative effort with partners and stakeholders to develop a formal Delta Flood Emergency Preparedness, Response and Recovery Program.

Some building block concepts may no longer be applicable to the DRMS process considering the progress and findings of other Delta planning initiatives and related issues. An example of such a building block is the reduced export concept. Consistent with the DRMS and the purposes of the Delta Habitat Conservation and Conveyance Program (DHCCP) and Bay-Delta Conservation Plan (BDCP), it is important that DRMS processes consider the management of risk to the ecosystem to enhance resources, and the risk reduction strategies for the protection of water resources of interests reliant on the Delta. The DHCCP was initiated under the Governor's direction to protect the Delta, prompting studies to assess potential habitat restoration and water conveyance options in this region. The DHCCP will conduct an environmental review to analyze BDCP proposed habitat restoration and water conveyance actions and alternatives through a formal EIR/EIS process. Since neither the BDCP nor DHCCP is considering a reduced export option, it is suggested that this option be removed from the Phase 2 DRMS report in its public release form.

Section 1 - Introduction.

Phase 2 Report Summary: AB 1200 (Laird, Chaptered October 2005) required DWR to evaluate the potential impacts on water supplies derived from the Delta resulting from a variety of risks, including , subsidence, earthquakes, floods, and changes in precipitation, temperature,

and ocean levels. It required, among other issues, that DWR shall evaluate and comparatively rate each risk reduction option to prevent the disruption of water supplies and improve the quality of drinking water derived from the Delta.

A summary of the objectives for the DRMS per of AB 1200 under present and future conditions for individual and combined islands include development of (1) risk to state (water export disruption, etc.) and Delta (infrastructure, ecosystem, etc.) with levee failures due to seismic, flood, subsidence, seepage and sea-level rise hazards, (2) criteria for consideration of alternative risk management strategies, and (3) prioritized actions to reduce and manage the risks from Delta levee failures.

Phase 1 implements a risk analysis model to analyze the risk-based consequences of disruption of services within the Delta, resulting from the failure of the levees system or other infrastructure due to seismic, flood and other risks. Building on Phase 1, Phase 2 is focused on analyzing net benefits and costs of risk reduction strategies to resources and assets of the Delta through development of building blocks and scenarios. The building blocks cannot be further divided into sub-components and maintain their functionality. A scenario is a combination of building blocks, providing multiple risk reduction benefits. Together, these provide a set of options and risk reduction evaluation tools for decision-making.

There are related initiatives to the DRMS process, such as Delta Vision, BDCP and CALFED. The Delta Vision process is to identify a strategy for managing the Delta as a sustainable system for all environmental resources, economic services, including related policies and resource management strategies, and emergency preparedness and response plan for a catastrophic event. Delta Vision would, among other initiatives, use subject matter from the DRMS project.

The BDCP addresses water operations and facilities in the legal Delta, primarily on aquatic ecosystems and natural communities, but also riparian and floodplain natural communities. It provides for (1) conservation and management of covered species, (2) preservation, restoration and enhancement of aquatic, riparian and associated terrestrial habitats, and (3) clear expectations and regulatory assurances for the water operations and facilities. The results from DRMS will provide levee risk information to inform the BDCP process.

CALFED is preparing an assessment of performance towards objectives during Stage 1 (first 7 years of implementation) and the likelihood the program will meet its objectives in the future. Levees play a major role as to how the CALFED program is implemented in the future. CALFED will use the results of DRMS to inform its planning process.

MWD Comments: As noted, the DRMS purpose is to assess the performance of Delta and Suisun Marsh levees (under various stressors and hazards) and the various consequences of levee failures to the Delta region and to California as a whole (Phase 1) and to develop and evaluate risk reduction strategies (Phase 2). In this connection and consistent with the purposes of the DHCCP and BDCP, it is important that DRMS processes consider the management of risk to the ecosystem to enhance resources, and the risk reduction strategies for the protection of water resources of interests reliant on the Delta.

The Delta Habitat Conservation and Conveyance Program (DHCCP) was initiated under the Governor's direction to protect the Delta, prompting studies to assess potential habitat restoration and water conveyance options in this region. The DHCCP will conduct an environmental review to analyze BDCP proposed habitat restoration and water conveyance actions and alternatives through a formal EIR/EIS process. Some concepts of the BDCP have surpassed the DRMS level of analyses and care should be taken to include both current, applicable analyses and findings.

The Steering Committee and State Water Contractors have emphasized the importance of identifying the separable net economic benefits of building blocks to provide the opportunity for trade off evaluations essential to the development of optimized scenarios with broad, economically justified and balanced benefits. The Phase 1 DRMS report excluded a broad evaluation of the net economic benefits of building blocks, and the Phase 2 DRMS report does not perform this task. The crafting of various building blocks into overall scenarios should first identify the separable benefits of its component parts (building blocks). The combining of a series of Delta actions for benefit assessment tends to mask the values of individual risk reduction strategies. Clear, basic reporting and comparative methodologies are needed for economic benefit analyses.

The DRMS process has recognized that the evaluation of optimized scenarios require an iterative process, taking advantage of the knowledge gained from initial iterations and making adjustments in analyses to achieve more balanced, optimized scenarios.

Section 2 - Building Blocks and Scenarios.

Phase 2 Report Summary: The categories of building blocks included (1) conveyance and flood risk reduction, (2) infrastructure risk reduction, and (3) environmental risk mitigation. The building blocks were developed to a level of engineering detail to enable verification of their technical feasibility and constructability. Further, conceptual designs were developed for each building block with enough detail to allow estimation of construction quantities, material sources and construction costs. Scenarios consist of combinations of building blocks providing risk-reduction value to many assets and resources as a whole.

MWD Comments: As early as 2006, the Steering Committee and separately the State Water Contractors emphasized the importance of identifying the separable net benefits of building blocks to provide the opportunity for trade off evaluations essential to the development of optimized scenarios with broad, economically justified and balanced benefits. As noted herein, the Phase 2 DRMS report does not perform this task. The risk reduction associated with building blocks is estimated on quantitative and qualitative levels, providing in some cases inconsistent measures of benefit and cost presentation making systematic comparisons obscure. The crafting of various building blocks into overall scenarios should have first identified the separable benefits of its component parts (building blocks). A consequence of this approach is that the report does not identify the essential separable benefits of principal conveyance improvements of Improved Levees, Through-Delta Conveyance (Armored, Semi-Isolated Pathway), Isolated Conveyance Facility or Dual Conveyance scenarios, but rather accumulates the benefits of other

habitat enhancement, infrastructure upgrades and land use building blocks with these improvements, masking the separable economic justification of the conveyance improvements.

Section 3 - Improved Delta Levee Maintenance.

Phase 2 Report Summary: The Delta Levees Program includes the Delta Levees Maintenance Subvention Program (Subvention Program), which provides matching funds to assist with levee maintenance and improvements and is available to all levee-maintaining agencies throughout the Delta; and the Delta Levees Flood Control Special Projects Program (Special Projects Program), which supports work on islands of special importance.

The purpose is to enhance levee maintenance through more continuity, programmatic mitigation, and a higher level of state support of the Subvention Program. The benefits would include lessening the risk of levee failures, protecting the functionality of Delta assets and infrastructure, and providing continuation of Delta services received by the state.

This building block considers a legislative and DWR commitment to provide continuously appropriated and increased funding for the Subvention Program to enhance levee maintenance at about \$12 million/year or about \$25 million/year. With continuous appropriations, local assistance funds could be kept solvent and appropriated to support work in progress. Work agreements could be prepared and approved before passage of the state budget, taking advantage of the calendar window for waterside work. The result is expected to be a lessening of levee failure risk from sunny-day events and small- and medium-sized floods. The scope of this building block does not include increased funding for the Special Projects Program.

MWD Comments: Costs and engineering analyses for maintenance upgrades are provided, but a common quantified economic benefit analyses for comparison is lacking. Improved levee maintenance by function or region of the Delta would be helpful to provide defined regional levee benefits for purposes assessing export reliability or protection to life and property.

Section 4 – Upgraded Delta Levees.

Phase 2 Report Summary: The purpose would be to assess upgrades to Delta levees to reduce risk and likelihood of failures. Selected Delta levees (about 764 miles of levees) would be upgraded to PL 84-99 standards and selected Delta levees (about 187 miles of levees) would be upgraded to Urban Project Levee Standards. It confirms feasibility and evaluates risk reduction for differing subsurface conditions of no peat, 10 feet of peat, 20 feet of peat, 30 feet of peat and 40 feet of peat. The report notes that most of the Delta levees already meet the Hazard Mitigation Plan standards, and that some levees in the central Delta already meet the PL 84-99 standards. Upgrading levees to meet the PL 84-99 and UPL standards would reduce the flood risk and provide 100-year flood protection.

The costs to upgrade the selected levees to PL 84-99 and UPL standards are estimated at \$1,196 million and \$750 million, respectively. Cost estimates are based on the use of on-island fill. Unlike PL 84-99 standards, upgrades to UPL standards call for placement of rock fill on the waterside slopes of the affected levees.

The combined upgrade of the levees to the PL 84-99 and the UPL standards would result in a reduced probability of flood-induced failure. Upgrading levees to the PL 84-99 and UPL standards are expected to do little to reduce the risk of breach under seismic loading.

MWD Comments: The study appropriately focused on three levee failure risk categories: sunny-day levee failures, flooding and seismic events, however several levels of protection (e.g. HMP, PL 84-99, urban standard or full seismic upgrades) could be considered to observe tradeoffs in costs and benefits. Lesser levels of protection may be provided to assess levees that may fail, but not justify repair and recovery, thereby reducing long-term costs. Variable levels of protection may also be provided on different groupings of islands depending on land use (e.g., urban or agriculture).

The Delta is almost certain to change and the risk analysis should reflect this. While it is more difficult to analyze random future events (e.g. which islands flood and remain flooded), the current assumption of forever repairing and reclaiming all Delta islands should be revisited with respect to costs and benefits.

Costs and engineering analyses of upgrades are provided, but a common quantified economic benefit analysis of levee improvements in terms of exceedences considering costs integrated for all probabilities is lacking for comparative purposes. Levee improvements are not isolated by function or region of the Delta, but rather only by broad upgrades across the Delta. As a result, enhanced regional levee benefits for purposes of export reliability or protection to life and property in the Delta are not clear.

The identification of separable net benefits of building blocks provides the opportunity for trade off evaluation, and is essential to the development of economically justified and balanced scenarios. This is particularly important with regard to upgraded Delta levees, since levee improvements are often added to other conveyance measures in scenario development, which can mask benefits of the levees improvements and the primary conveyance features.

Planning is ongoing for the advance placement of redundant stockpiles of rock and other emergency materials to repair levee breaches and seismically-induced levee slumping in the event of a catastrophic multi-island failure to help generate an adequate flood-fighting platform and facilitate restoration of the emergency freshwater pathway. Under direction of MWD, Washington Group International and later URS has performed levee stability analyses along freshwater emergency pathway reaches of Middle River and Victoria Canal to assess levee slumping under 100-year, 200-year and 500-year probabilistic ground accelerations provided in the DRMS Phase 1 report. Results vary from a few feet of slumping up to ten feet of slumping under existing conditions, in many cases without levee failure. The objective was to determine under what conditions an adequate flood-fighting platform would be available for emergency operations after a major seismic event.

Section 5 - Enhanced Emergency Preparedness/Response.

Phase 2 Report Summary: DWR Division of Flood Management is the focal point for DWR's response to flood emergencies and management of flood-fighting efforts in the context of the state's Standardized Emergency Response System. The most visible entity in an actual emergency is the state-federal Flood Operations Center (FOC), which manages DWR's on-the-ground efforts during an emergency in anticipation of or in response to a flood event on a 24 hours per day basis until the emergency passes or is stabilized. The FOC has extensive experience with rainfall-caused river floods and high-tide and storm caused wind-wave threats to levees in the Delta levees.

DWR has developed an Interim Emergency Operations Plan for major Delta emergencies and has initiated a collaborative effort with partners and stakeholders to develop a formal Delta Flood Emergency Preparedness, Response and Recovery Program, as a vehicle for considering needs and actions to enhance emergency preparedness and response for major Delta levee breach events.

Four DWR material caches of tools and supplies maintained for use in Delta flood fights, are presently being expanded to include rock, sand and other materials. DWR is developing material and response expediting strategies in anticipation of a substantial state role in response to a major Delta levee incident. MWD analyses indicate that resumption of water exports may be facilitated by placement of structural barriers at selected channel locations and strategic levee repairs to isolate an emergency freshwater conveyance "pathway" through channels that may be surrounded by islands flooded with saline water. The pathway generally follows the Delta Cross Channel, Lower Mokelumne River, Middle River and the Victoria Canal.

The purpose is to identify planning, organizational or other actions for better-organized and more-effective DWR response to a major levee breach incident and to reduce adverse consequences. Only levees and water quality within DWR's emergency response are addressed within the Standardized Emergency Response System. It includes effective interaction with agencies having overlapping or joint responsibilities such as the U.S. Army Corps of Engineers and the U.S. Bureau of Reclamation. It addresses both plans for and the organization of emergency management and the emergency preparation measures. Many other dimensions of emergency response are not addressed in this building block (evacuation, rescue, public health, etc.).

The objective is a continuing commitment on the part of the state to enhanced emergency preparedness and response for a Delta levee emergency. Optional capital expenditures of \$50 million and \$100 million are identified. DWR and Phase 2 DRMS are considering a broad collection of transfer facilities, pre-positioned material and other emergency response preparations. Objectives are to increase the effectiveness of these operations and reduce the response times to substantially avoid adverse consequences. DRMS Phase 2 analysis assumes annual budgets of \$2-3 million to maintain and manage inventories, organizations and personnel for ready response. Short-term (1-2 years) and intermediate term (2-5 years) achievements are emphasized, considering time to perform strategic analyses and to define terms a condition of response.

The DRMS risk analysis model and their current emergency response approach provides explicit identification of functional responsibilities and responsible parties for expedited, effective response. Particularly DWR identifies and is implementing such measures as a robust Delta Emergency Operation Plan, formalized emergency management measures, ER&R and WAM models for analysis purposes, standard emergency operating procedures, priority systems for repairs, standard designs, prefabricated systems, strategically located sites for pre-positioned materials, equipment and transfer facilities, rock inventories, advance marine and ground construction resources, and consideration of specific emergency freshwater conveyance routes as such as the “emergency freshwater pathway”. Considering the above, DWR is providing specific improvements for emergency preparedness, response and recovery in coordination with other agencies such as Cal EMA and the Corps of Engineers. The Phase 2 Report finds that enhanced emergency preparedness and response can make a contribution to reducing adverse impacts from levee breach incidents.

MWD Comments: The catastrophic failure of the New Orleans levee system following the Katrina hurricane in 2005 prompted concern among water stakeholders, DWR and the Corps, and the coordinated preparation of emergency response plans for the Delta. The DRMS Phase 2 report notes the DWR Delta Flood Emergency Preparedness, Response and Recovery Program, being undertaken in coordination with the Corps of Engineers Delta Emergency Operations Plan, local emergency operations plans and water stakeholders, and within the broader auspices of the Office of Emergency Services, is due for draft release in 2011. As noted in the Phase 2 report, this covers a range of emergency response strategies from isolated single-island failures, up to and including major catastrophic multiple-island failures causing disruption to the vast majority of the Delta and to water exports. This Program is expected to improve response and minimize recovery time in the Delta focusing on (1) life, property, critical infrastructure and environment, (2) water quality impacts of interests reliant on the Delta, and (3) coordinated sequential or simultaneous response to isolated or multiple levee breaks. The DRMS Phase 2 report should continue to reference the DWR Delta Flood Emergency, Response and Recovery Program as a vital mechanism for the protection of life and property in the Delta, and to water supply interests reliant on the Delta.

Water interests reliant on the Delta have engaged extensively with DWR and the Corps in the preparation of Delta emergency response plans because of the unique needs and priorities these interests share under a severe multi-island failure. These needs include advance placement of redundant stockpiles of rock and other emergency materials for emergency response involving restoration of an emergency freshwater pathway following catastrophic multi-island failures. Water interests also support reasonable advance pathway levee improvements to improve seismic response and minimize levee slumping during seismic events. The restoration of an emergency freshwater pathway to export facilities in a large scale emergency would require the coordinated response largely of the Corps with the support of DWR to minimize water export disruptions, which water interest studies have shown could be reduced to about 6 months with pathway restoration.

Water interests, DWR and the Corps recognize that risk mitigation measures can facilitate emergency response particularly to catastrophic multi-island failures. Planning and

implementation is ongoing for the advance placement of redundant stockpiles to repair levee breaches and seismically-induced levee slumping in the event of a catastrophic multi-island failure to help generate an adequate flood-fighting platform and facilitate restoration of the emergency freshwater pathway. Collectively, such measures are being supported through ongoing programs such as the (1) DWR Delta Levees Special Projects Program, (2) the DWR Flood Risk Reduction Plan, (3) the Corps Delta Levee Stability Program and (4) the Corps Delta Islands and Levees Feasibility Study.

Delta levee improvements have been provided through ongoing programs to benefit life and property in the Delta, research related to levees, subsidence reversal and ecosystem enhancement. Prioritizing criteria should further address levee improvements benefiting statewide entities reliant on export water supplies, particularly those benefiting short-term or long-term water conveyance needs following catastrophic multiple-island failures from earthquake or flood. Levee improvements providing overlapping benefits to interests in the Delta region and statewide should be identified. A coordinated budgeting approach for levee improvements among state, federal, water interest and reclamation district programs is critical.

Emphasis should also be placed on the Sacramento-San Joaquin Delta Multi-Hazard Coordination Act of 2008 (SB 27) which directed that a Delta Multi-Hazard Coordination Task Force led by Cal EMA was to“Coordinate the development of a draft emergency preparedness and response strategy for the Delta region for submission to the Director of the OES. Where possible, the strategy shall utilize existing interagency plans and processes...” Specifically, the DWR Delta Flood Emergency Preparedness, Response and Recovery Program, now being undertaken and due for draft release in 2011, addresses this directive. Current analyses and coordinated efforts have brought the justification and acceptance of the emergency freshwater pathway concept into clear focus, providing the basis for integrated planning and budgeting initiatives toward implementation.

Section 6 - Pre-Flooding of Selected Islands.

Phase 2 Report Summary: The purpose of pre-flooding selected islands is to reduce the risk of accidental flooding that may cause excessive salt intrusion. The objectives are to determine whether pre-flooded islands left open to tidal exchange significantly alter the salinity regime in the system, and how much benefit in terms of recovery from a levee failure event is derived by pre-flooding. This action is thought to reduce the disruption of Delta exports and the export deficit associated with large-scale levee failure events when exports are resumed. The analyses did not consider residence time or water quality issues other than salinity.

Options for pre-flooded islands might consider (1) allowing surrounding levees to naturally degrade with wind-wave action after a controlled breach similar to Franks Tract, (2) careful design and construction of breaches and armoring levee interiors to preserve the levees and control tidal flow in and around the flooded islands, or (3) armoring to preserve surrounding levees for use of flooded islands as in-Delta reservoirs similar to Delta Wetlands.

Three sets of islands were evaluated in the western, eastern, and southern Delta, and a fourth 20-island set.

Western Delta: Sherman, Jersey, Bradford, Twitchell, Brannan-Andrus

Eastern Delta: Venice, Mandeville, McDonald, Jones, Bouldin

Southern Delta: Palm-Orwood, Bacon, Woodward, Jones, Victoria, Byron

20 Islands: Sherman, Jersey, Bradford, Twitchell, Brannan-Andrus, Venice, Mandeville, McDonald, Jones (Upper and Lower), Bouldin, Palm-Orwood, Bacon, Woodward, Victoria, Byron, Bethel, Webb, Holland and Quimby.

The report finds that that pre-flooding Delta islands may reduce the disruption of Delta exports and the export deficit. Breaching islands in the western Delta increases mixing and the dispersive flux of salt into the central Delta. Breaching islands in the interior of the Delta causes some increase in salt flux. A favorable option may be selecting sets of islands in the south Delta and leaving those islands closed to tidal exchange. Further analysis is required to consider a wider range of breach scenarios, hydrology and island groups.

The study concludes western Delta islands should not be breached and left open to tidal exchange due to the resulting increase in dispersive salt flux into the central Delta. In other areas of the Delta it finds that hardening Delta islands against failure or pre-flooding islands and leaving them closed to tidal exchange may also be superior because of salt accumulation in the islands.

MWD Comments: Hydrodynamic analyses appear appropriate; however, no analysis of comparative net economic benefits has been performed to support findings and recommendations. Potential pre-flooding could also consider islands that do not significantly impact agricultural interests, but provide export water quality benefit or strategic water conveyance value for emergency or long-term needs. Certain islands could fail, but not justify repair and recovery, thereby reducing long-term costs. In addition, refined groupings of islands should be assessed, particularly south Delta islands where rapid salinity intrusion following major levee breaches results in residual salinity impacts which are difficult to flush out or dilute. Variable levels of protection on different groupings of islands may be warranted depending on land use (e.g., urban or agriculture).

The release or production of organic carbon, tri-halomethane precursors or other constituents from soils within the islands create issues for water exports intended for municipal water supply. Specifically, analyses should be performed to assess concentrations of dissolved organic carbon and bromide at the export pumps, since these constituents have significant economic consequences to water users.

The Delta is almost certain to change and the risk analysis should reflect this. While it is more difficult to analyze random future events (e.g. which islands flood and remain flooded), the current assumption of forever repairing and reclaiming all Delta islands should be revisited with respect to costs and benefits.

Section 7 - Land Use Changes to Reduce Island Subsidence.

Phase 2 Report Summary: The purpose is to estimate reduction in risks and benefits associated with constructing wetlands on Delta peat islands. The relevant change in subsidence is the net change that will occur for the newly constructed wetlands (biomass accretion) relative to the previous land use (peat decomposition). Benefits are thought to include improved levee stability through reduced hydrostatic head, reduced probability of levee breach and salinity intrusion, minimization of discharge of greenhouse gases, net accretion of carbon, habitat creation for listed species, and increased recreational use of islands.

The building block has been developed from literature and findings from the work at the Twitchell Island. It identifies a number of islands where large-scale carbon sequestration could be implemented, develops the conceptual design, and quantifies cost and benefits. Sites were selected where subsidence and island likelihood of flooding are greatest, disruption to infrastructure and agricultural production are least, and where the variation in island elevation is least. The key design criteria that can be used to achieve the project objectives are ponding depth, planting and seeding and nutrients.

Among other findings, the DRMS report notes that wetlands creation can be used to reverse subsidence where ponding depth and plant species are optimized, island topography is conducive to wetlands formation, construction costs may be around \$20,000 to \$27,000 per acre, carbon sequestration improves biodiversity, subsidence reversal, reduction in greenhouse gases, habitat formation for listed species, and reduced probability of levee breach effects.

It concludes that carbon sequestration has been successful in reversing subsidence and accreting organic carbon over time, however, more needs to be known about how this accretion will reduce the risk consequences noted herein.

MWD Comments: Analyses methods and findings appear reasonable, however a common basis of economic justification and comparison is needed at wetlands creation sites. Proposed land use changes which reduce subsidence are expected to provide benefits from carbon sequestration. It should be emphasized that subsidence increases effective height to levees, yielding a significant increase to the hydrostatic forces on levees and in the accommodation space (“gulp”) experienced on islands.

Section 8 - Armored “Pathway” (Through-Delta Conveyance).

Phase 2 Report Summary: The purpose is to evaluate the concept of a north-to-south freshwater corridor along Middle River that uses modifications of existing Delta infrastructure while reducing the potential for seismic disruptions of water supply. It would move freshwater from the Sacramento River to the State Water Project and Central Valley Project intake facilities, redirecting a larger portion of the Sacramento River flows southward through north Delta channels to Middle River and Victoria Canal. It is expected to improve water quality throughout the Delta.

The main objective behind the armored pathway is the ability to quickly reestablish freshwater conveyance to the project pumps in the advent of a major disruption to the Delta levees and the resulting salinity impacts that could result. If the time required for reestablishing water exports can be significantly reduced, it is thought those impacts can be avoided.

The armored pathway includes the an inlet facility and fish screen on the Sacramento River near Hood, dredging of the alignment, seismic-resistant setback levees along the alignment, restoration of riparian habitat on the levees, barrier gates and bridges. The report finds that the costs would range from \$5.7 billion for 15,000 cfs to \$3.5 billion in for 5,000 cfs in 2007 dollars. It is believed that the armored pathway provides a reasonable way to maintain freshwater delivery in the south Delta. The design is feasible from engineering perspective and minimally intrusive to the community. Benefits would include improved recovery from major levee breaches, improved reliability of normal water delivery, improved water quality, and improved riparian habitat.

MWD Comments: This is not a long-term conveyance solution being considered under either the BDCP or DHCCP. It is semi-isolated, requiring additional detail in isolation of flows in the critical reaches from the San Joaquin River to the export pumps. Analyses are needed with respect to a variety of impact categories such as sea level rise, salvage, trucking and handling of fish, organic carbon and tri-halomethane precursors, and San Joaquin and Mokelumne salmon. Dredging for adequate capacity may be needed in certain reaches.

Section 9 - Isolated Conveyance Facility Alternatives.

Phase 2 Report Summary: The purpose is to evaluate risk reductions of an ICF on Delta habitat, water supply reliability, water quality, and flood protection. It provides a north-to-south freshwater corridor through the construction of an isolated canal around the eastern periphery of the Delta.

It considers capacities of 5,000, 10,000, and 15,000 cubic feet per second (cfs), consisting of about 44 miles of unlined earth canal extending from the Sacramento River at Hood to the SWP and the CVP pumping plants at Clifton Court in the south Delta. Related facilities include an intake structure with fish screens on the Sacramento River at Hood, eleven inverted siphons, four flow control structures, and a pumping plant near Disappointment Slough. An alternate alignment incorporates a shift of portions of the canal to the west to avoid residential encroachment and take advantage of lower land prices in the Primary Zone. An “incised” canal option places the pumping station at the downstream end of the canal. A “raised” canal option places the pumping station midstream, near Disappointment Slough. The risk reduction estimate addresses water quality, water delivery reliability and operational flexibility.

MWD Comments: Two east Delta Isolated Facility routes are presented, as documented in the report, Isolated Facility, Incised Canal Bay-Delta System, Estimate of Construction Costs, Washington Group International, August 2006. These appear to be reasonable inputs to and consistent with analyses currently being conducted under the DHCCP and BDCP. However, their applicability in the current status of these programs should be reviewed.

Section 10 - San Joaquin Bypass.

Phase 2 Report Summary: The San Joaquin Bypass is a potential habitat enhancement and flood management option providing flood control benefits to regions east of the San Joaquin River between Lathrop and Stockton, as well as portions of Stewart Tract and Roberts Island.

It use all or portions of Stewart Tract and Roberts Island to divert San Joaquin River floodwaters away from the populated areas along the east bank of the river through (1) diversion into a separate channel or floodway on Stewart Tract and Roberts Island, diverted south of Lathrop and discharged back into the river north of Stockton, or (2) by creating a floodplain by construction of a setback levee along the west bank of the San Joaquin River such that floodwaters are spread onto portions of Stewart Tract and Roberts Island, thereby lowering water surface elevations next to developed areas.

The objectives are to protect lives and property; and to create a floodplain habitat and if feasible, marshland to provide more habitats for fish, waterfowl, and wildlife, and improved aquatic foodweb production and water quality. The recommended plan is expected to provide cost effective net benefits to agriculture, infrastructure, land values and habitat.

MWD Comments: The analyses do not appear to address impacts and tradeoffs of flood risks imposed further downstream into the Delta. The concept should be evaluated for consistency with BDCP CM5 Seasonally Inundated Floodplain Restoration, which is considering restoration of seasonally inundated floodplain habitat within the north, east, and/or south Delta. It should be coordinated with the Corps of Engineers with respect to the Delta Islands and Levees Feasibility Study (Delta Study) addressing ecosystem restoration needs, flood risk management problems and related water resources in this region, and with respect to the Corps Lower San Joaquin Feasibility Study, which is analyzing federal interest in flood risk management and ecosystem restoration improvements along the Lower San Joaquin River.

Section 11 - Raise State Highways.

Phase 2 Report Summary: This would raise SR 4, SR 12, and SR 160 above the Federal Emergency Management Agency (FEMA) 100-year flood elevation and constructing them on piers with a seismically resistant design to reduce the risk of damage and failure. It does not evaluate local access to the new elevated structures and future expansion plans of these highways. This is expected to reduce the risk of potential loss of usability of SR 4, SR 12, and SR 160 due to flooding and earthquake damage, and provide for uninterrupted operation of these transportation corridors for emergency response and evacuation.

Costs of raising state highways are estimated at \$6.1 billion. It is thought that intangible benefits could be significant with elevated highways serving as access routes for emergency evacuation and repairs, and alternative route for freight movement if railroads were disrupted.

MWD Comments: Raising Highways SR 4, SR 12, and SR 160 above the 100-year FEMA flood level would yield the benefit of continued access on these highways for various purposes

under a severe multi island failure. Costs are established, but separable economic benefits are not estimated, making the independent economic justification of this action obscure. Separable benefit analyses of raising all highways against the benefits received would determine economic justification by incremental levels of improvement.

Other considerations may include investing a portion of the funds for enlarging Highway 4 on widening existing alignments of I-5, I-205 and the Byron Highway from Tracy to Brentwood. Similarly, Highway 160 improvements might be limited to the section from Rio Vista to Antioch. Combining levee improvements could be considered for Highway 12 with levee realignments to establish a primary northern levee for Bouldin Island, and creating additional riparian habitat on the Mokelumne River.

Section 12 - Armored Infrastructure Corridor.

Phase 2 Report Summary: This evaluates the feasibility of constructing an armored infrastructure corridor with new levees to reduce the risk of flooding, seismic activity or both. The objectives are to reduce the risk to this infrastructure and provide uninterrupted operation of the infrastructure for water supply, fuel supply, emergency response and freight transport. The new levees would be seismically resistant and would have elevations above the 100-year FEMA flood elevation. Infrastructure would be relocated to the corridor. Two options include (1) constructing a northern levee and a southern levee, relocating SR 4 on the new southern levee and the BNSF railroad on the new northern levee, and leaving the Mokelumne Aqueduct system and the Kinder Morgan pipeline unaffected, or (2) constructing a single, larger levee to the south of the existing Mokelumne Aqueduct to carry the new SR 4, the BNSF railroad, the Mokelumne Aqueduct system, and the Kinder Morgan pipeline.

The estimated costs of the options would range from \$3.3 to \$3.9 billion. More study is needed on the number of local access points, future plans for the infrastructure and the avoided costs and impacts.

MWD Comments: This yields the benefit of continued access and utility continuity using a common facility under a severe multi-island failure. Costs are established, but separable economic benefits are not estimated, making the independent economic justification of this action obscure.

Section 13 - Suisun Marsh Tidal Wetland Restoration and Managed Wetland Enhancements.

Phase 2 Report Summary: The purpose is tidal marsh restoration and managed wetland enhancement. Restoration plans follow criteria of land surface elevation, connectivity with upland habitats, connectivity with existing tidal wetland habitats, transportation infrastructure, land ownership, sediment sources and minimizing salinity impacts. The report does not recommend land acquisition or further examine the draft Suisun Marsh Habitat Management, Preservation, and Restoration Plan (Suisun Marsh Plan). It relies on existing knowledge, particularly the Suisun Marsh Plan, in identifying areas of tidal restoration and associated levee abandonment.

Its goals address ecological processes, habitats, levee system integrity, non-native invasive species, water quality, sediment quality, and public use/waterfowl hunting. The objectives are to conceptually identify managed wetlands (or diked lands) that could be converted to tidal wetlands, develop structural measures to enhance remaining managed wetlands and develop conceptual designs and costs. It would upgrade levees to Suisun Marsh levee standards, reduces risk of failure and consequences to managed wetlands and species, restores tidal action and decreases the potential for catastrophic levee failure.

The estimated cost is about \$167 million, including restoring 5,900 acres of tidal wetland at about \$32 million, and enhancement of 25,000 acres of managed wetland at about \$135 million. Tidal restoration costs range from \$3,000 to \$9,000 per acre, including land acquisition, design, new levee construction, levee upgrades, mobilization/demobilization and contingencies.

The report finds that the large scale tidal wetland restoration in Suisun Marsh would be relatively cost-effective, potentially enhance and diversify Suisun Marsh habitats for species protection, help reduce the risk of catastrophic levee failure and levee maintenance costs, and provide opportunities for research. Further feasibility analysis is needed using accurate topography, sediment transport, and Marsh hydrodynamic and ownership information, including integration with ongoing planning initiatives.

MWD Comments: It should be noted that the habitat and tidal wetlands restoration provided by this plan not only creates food supply for fish, but with its tidal marsh accretion reduces potential flooding due to seismic activity or other risks. Cost and subjective benefits are listed, but separable economic benefits are not estimated, making the independent economic justification of this action obscure. The San Joaquin Bypass should be evaluated for consistency with BDCP CM4 Tidal Habitat Restoration and other BDCP conservation measures. The concept should be coordinated with the Corps of Engineers with respect to the Delta Islands and Levees Feasibility Study (Delta Study) addressing ecosystem restoration needs, flood risk management problems and related water resources in this region.

Section 14- Tidal Marsh Cache Slough Restoration.

Phase 2 Report Summary: The purpose is to create a conceptual preservation and restoration plan for the Cache Slough Complex to restore the ecology of the region. It is based on a plans and habitat restoration goals presented in a collection of plans by various agencies supporting Delta conservation, including the Solano Land Trust (SLT), the Bay-Delta Conservation Plan (BDCP), and others. It is essential in meeting the objectives set out by the U.S. Fish and Wildlife Service (USFWS). The study area includes the Cache Slough Complex, within the 100-year floodplain bordered in the northeast by the Yolo Bypass, including some portion of the bypass area, and Prospect Island on the east.

The objective is to utilize and expand on existing regional habitat goals, restoration objectives and management plans for the Cache Slough area to guide the design of the conceptual restoration plan. Existing data on delta smelt captured in the Cache Slough area were the basis for estimating the potential of Cache Slough area restoration to increase spawning habitat.

Criteria for the restoration plan were obtained from general and specific habitat goals outlined in restoration plans for the Cache Slough area, including Solano Land Trust, the Bay Delta Conservation Plan and others.

The general strategy is to protect and enlarge remaining habitat and establish connectivity to these areas as proposed by a large number of restoration initiatives, including the Bay-Delta Conservation Plan and as considered for a North Delta National Wildlife Refuge by the USFWS. For example, the BDCP (2000) envisions a North Delta Corridor that provides large contiguous habitat corridor that connects the mosaic of tidal marsh, seasonal floodplain, riparian and grassland habitats in the Yolo Bypass, Cache Slough Complex, Jepson Prairie Preserve, Prospect Island, Little Holland Tract, Liberty Island and Steamboat Slough.

Barriers dividing the 100-year floodplain in the Cache Slough Complex could be removed, with selected levees breached or constructed. Tidal inundation would be restored to Cache Slough, increasing the connectivity of uplands and waterways for increased habitat to listed species, as well as providing important spawning habitat for delta smelt. Benefits include improved biodiversity, reduced costs for levee maintenance, reducing island subsidence and reducing potential salinity intrusion. Constraints include loss of agricultural production, environmental risks such as invasion by Brazilian waterweed and impacts to infrastructure.

The conceptual-level cost estimate for restoration of 33,690 acres under the Tidal Marsh Cache Slough Restoration project ranges from \$426 to \$921 million. The cost range is influenced largely by land acquisition methods, specifically conservation easements vs. fee purchase. Construction costs are influenced by the presence of endangered species during construction, and time of year to breach levees relative to winter and spring floods. Additional data collection is required to refine costs, mainly on land acquisition methods. Further modeling would also be required to refine breach locations, number and characteristics of breaches.

Increasing the available habitat and food supply for many endangered species in the Delta, including Delta smelt, reduces species risk. Expansion of the Yolo Bypass floodplain reduces hydrostatic pressure and risk of breach on upstream levees, while flooding of breached islands may reduce salinity intrusion by altering the distribution of the tidal prism.

The conservation and restoration of 33,000 acres described herein would connect with 12,000 acres of restored areas, resulting in a total contiguous area of habitat of 45,000 acres. Connecting to existing restoration areas creates large areas of restored habitats beneficial to wildlife and fish species, while connecting wetland and upland habitats. Further studies are needed on species composition and production, hydrological processes, sedimentation, water quality and benefits to native fish from increased open water and tidal marsh habitats, and delta smelt spawning habitat.

MWD Comments: Cost and subjective benefits are listed, but separable economic benefits are not estimated, making the independent economic justification of this action obscure. Improvements at Cache Slough that impact the existing North Bay Aqueduct Intake, should include the cost to relocate the aqueduct intake. The San Joaquin Bypass should be evaluated for consistency with BDCP CM2 Yolo Bypass Fishery Enhancement and BDCP CM5 Seasonally

Inundated Floodplain Restoration. The concept should be coordinated with the Corps of Engineers with respect to the Delta Islands and Levees Feasibility Study (Delta Study) addressing ecosystem restoration needs, flood risk management problems and related water resources in this region.

Section 15 - Install Fish Screens.

Phase 2 Report Summary: Fish screens are evaluated in the context of adding value to other actions that improve water supply reliability and fish protection, based on previous studies and costs. Screen concepts are considered viable using multiple screen modules at an Isolated Facility and at Banks and Tracy pumping plants, ranging from 4,000 cfs to 15,000 cfs. Screening of intakes is considered proven for 25 to 30 mm fish, unproven for eggs and larvae, and judged uncertain for fish collected and transported from the south Delta. South Delta fish screens are found less protective to fish than north Delta Isolated Facility screens because of debris problems, mortality of transporting bypassed fish, potential entrainment of smaller fish, and trapping fish in dead-end areas. South Delta screens were found more costly than north Delta Isolated Facility screens, because of poor foundation conditions, debris removal, transport of bypassed fish, and tidal influences and shallow water depths requiring larger facilities. The report makes no recommendations, rather suggesting reliance on earlier CALFED studies for the siting and locations for the intake and associated fish-screening facilities.

MWD Comments: Costs and subjective benefits are listed, but separable economic benefits are not estimated making economic justification obscure. Because fish screens do not mitigate risks such of sea level rise, earthquake induced damages or subsidence, it is suggested that this option be removed from the Phase 2 DRMS report in its public release form.

Section 16 - Setback Levees to Restore Shaded Riverine Habitat.

Phase 2 Report Summary: The building block involves the construction and landscape treatment of 20 to 30 miles of seismically repairable setback levees at cost from \$480 to \$720 million along Sutter Slough, Steamboat Slough, and the San Joaquin River. The levees would restore shaded riverine habitat and reduce the likelihood of levee failures due to seismic events. They would be considered “seismically repairable”, meaning they would deform and slump during a large earthquake, likely preventing complete failure and release of water, and be repairable after a major earthquake.

MWD Comments: The report notes that the building block and its levee improvements would be used in risk reduction evaluations. However, the scope of risk reduction evaluations which presumably would be the basis for further action are unclear. It is also unclear if a paper exercise or full scale construction is intended to confirm the engineering feasibility and risk reduction capability. The basis of selecting Sutter Slough, Steamboat Slough and the San Joaquin River are also not stated. The identification of separable net economic benefits of this building block is essential considering the large scale of potential expenditures.

Section 17 – Reduce Water Exports from the Delta.

Phase 2 Report Summary: The purpose is to explore the effects of decreasing water exports by 10 percent, 25 percent and 40 percent to determine effects to water users and fish, and under these conditions, the associated impacts to supplies and fish from major levee breaches. Reductions would apply to the California State Water Project (SWP) and the Central Valley Project (CVP), but not the Contra Costa Water District.

It notes that lessening impacts to fisheries by decreasing water exports will correspondingly reduce the state's vulnerability to a major Delta levee breach. Benefits are thought to be a reduction in salvage and stress to fish as exports are reduced, an improvement to export water quality by lessening tidal effects and exposure to peat, a reduction in carriage water needs, and a correspondingly reduction in risk from earthquake or flood.

It assumes urban agencies would replace lost supplies with water purchased from agricultural agencies, and conservation and local water sources such as recycling and desalination. Agricultural agencies would likely be forced to reduce agricultural production, and increasingly rely on conservation and groundwater.

However, findings are said to be uncertain. Urban and agricultural responses and impacts under normal conditions are thought to increase significantly as the size of the export reduction is increased. It is expected that exported water would transfer from agriculture to urban agencies, groundwater would be increasingly over drafted and additional land fallowing would occur.

Urban agency impacts would depend on their current reliance on the Delta, conservation efforts and use of emergency supplies. Agricultural impacts would probably include increased land fallowing, overdraft of groundwater basins and loss of additional high value, permanent crops. During major levee failures, island flooding is likely to produce very high mortalities to aquatic organisms depending on the population strength at the onset of the event.

MWD Comments: The study describes an evaluation process and attempts to draw subjective conclusions, but provides no quantitative modeling or economic basis of urban or agricultural effects to support its findings. From this, it judges that varying water exports over annual and multi-year cycles may offer benefits to fish while limiting impacts to water users.

The purpose of the Delta Risk Management Strategy (DRMS) project is to assess the performance of Delta and Suisun Marsh levees (under various stressors and hazards) and the various consequences of levee failures to the Delta region and to California as a whole (Phase 1) and to develop and evaluate risk reduction strategies (Phase 2). In this connection and consistent with the purposes of the DHCCP and BDCP, it follows that the management of risk to the ecosystem would focus on measures to enhance resources, and necessarily develop risk reduction strategies for the protection of water resources of interests reliant on the Delta. Alternatives that reduce water exports from the Delta would escalate risk to these resources, which appear to be beyond the defined scope of the Delta Risk Management Study.

The Delta Habitat Conservation and Conveyance Program (DHCCP) was initiated under the Governor's direction to protect the Delta, prompting studies to assess potential habitat restoration and water conveyance options in this region. The DHCCP will conduct an environmental review to analyze BDCP proposed habitat restoration and water conveyance actions and alternatives through a formal EIR/EIS process. Since neither the BDCP nor DHCCP is considering a reduced export option, it is suggested that this option be removed from the Phase 2 DRMS report in its public release form.

Section 18 - Scenario Evaluation (which also reviews Building Block development).

Phase 2 Report Summary: Scenarios include Improved Levees, Through-Delta Conveyance (Armored, Semi-Isolated Pathway), Isolated Conveyance Facility and Dual Conveyance, which in each case includes the combined benefits of other habitat enhancement, infrastructure upgrades and land use building blocks. For each scenario, the analyses estimate the reduction in frequency of levee failures and island flooding from the base case ("business as usual") from seismic and flood events, the economic costs and impacts in years 2005, 2050, and 2100 for each scenario, and the risk-reduction present worth benefit.

Improved Levees include central Delta levees upgraded to meet PL 84-99 standards, although some would be upgraded to Urban Project Levee (UPL) Standards. A Through-Delta Conveyance (Armored, Semi-Isolated Pathway), up to 15,000 cfs would be developed along Snodgrass Slough, North Fork Mokelumne River, Middle River and Victoria Canal. A 15,000 cfs Isolated Conveyance Facility (ICF) to the east of the Delta would include intake structures and fish screening at the upstream connection with the Sacramento River. A Dual Conveyance option would include a Through-Delta Conveyance (Armored, Semi-Isolated Pathway), and an Isolated Facility to the east of the Delta.

MWD Comments: The Steering Committee and separately the State Water Contractors have emphasized the importance of identifying the separable net benefits of building blocks to provide the opportunity for trade off evaluations essential to the development of optimized scenarios with broad, economically justified and balanced benefits. The Phase 2 DRMS report does not perform this task. The crafting of various building blocks into overall scenarios should have first identified the separable benefits of its component parts (building blocks). A consequence of this approach is that the report does not identify the essential separable benefits of conveyance improvements of Improved Levees, Through-Delta Conveyance (Armored, Semi-Isolated Pathway), Isolated Conveyance Facility or Dual Conveyance scenarios, but rather accumulates the benefits of other habitat enhancement, infrastructure upgrades and land use building blocks with these improvements, masking the separable economic justification of the principal conveyance improvements. As a result of the addition of other building blocks to these conveyance improvements, the net benefits of resulting scenarios converge and net conveyance benefits are obscured. Analyses for various hydraulic capacities of an Isolated Facility are also not provided.

For the hydrologic evaluations, the surrogate seasonal timing and hydrologic conditions must capture the more severe range of events. The probabilities and consequences need to be

integrated over the full range of possibilities, from high frequency, small consequence events to low frequency, large consequence events.

Scenarios include significant levee investments for most Delta islands with limited analyses of their continuing benefits and susceptibility to earthquake risk, sea level rise and continuing subsidence. The costs effectiveness of levee improvements should compare flood damages against cost of levee improvements. It is questionable why every Delta levee is perpetually maintained, including complete restoration after a large earthquake, as much of the investment may be lost within decades due to one or more of these risk factors. For example, the study could analyze a lower level of levee maintenance in the Dual Conveyance scenario, possibly continuing current maintenance funding or selective upgrades of individual islands to PL 84-99 standards.

Analyses should consider evidence of dissolved organic carbon and bromide at acceptable concentrations at the export pumps. These factors could have significant economic consequences and should be a prominent part of the analysis. Also, the analyses do not place an economic value on the ecosystem or water quality benefits.

Section 19 - Results and Observations.

No comments.

Section 20 - Assumptions and Limitations.

No comments.

Section 21 – References.

No comments.